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REVIEWS.

SUMMARIES OF THE LITERATURE OF STRUCTURAL MATERIALS. II.

EDWIN C. ECKEL.

BERKEY, C. P. *Origin and Distribution of Minnesota Clays.* Amer. Geologist, Vol. XXIX, pp. 171–177, March, 1902.

Residual clays, derived either from feldspathic rocks or from limestones, are of slight importance in Minnesota. The larger clay working establishments of the state are using shales, stream deposits, or glacial lake clays; the smaller brick plants of local importance use till or loess.

The shales of most importance are those of the Ordovician and Cretaceous. The Ordovician shales are found only in the southeastern portion of the state. Most beds are too calcareous for use, but one company in Minneapolis utilizes Ordovician shales in the manufacture of an exceptionally fine line of front and pressed brick. The Cretaceous shales are used in the manufacture of stoneware at Red Wing.

The clays may be divided as to origin into glacial till, glacial lake clays, glacial stream deposits, recent alluvial deposits, and wind deposits.

Locally the till includes clay deposits of workable size. These clays differ in character according to the drift in which they are inclosed. The "gray drift" which has been brought by ice movements from the north and northwest carried fine-grained, calcareous, light-burning clays, though in places weathering may have removed enough lime to give red-burning clays. The "red drift" brought in from the north and northwest carries coarser grained clays with an excess of iron, which consequently burn red.

Glacial lake clays, laid down in quiet water in interglacial periods, are confined to the eastern border of the state, where extensive deposits occur and are worked on a large scale.

Glacial stream deposits include the river silts deposited during the withdrawal of the ice. Clays of this type are worked on the Mississippi river between Minneapolis and Little Falls, and on the Missouri river between Shakopee and New Ulm. These clays are obtained from the terraces bordering the present river channels, and burn cream or gray. They are the most important of the Minnesota clays, large plants using them being located at Chaska and Minneapolis.

Recent alluvial deposits occur in the same areas as the last class and in many cases cannot be differentiated from them.

Most of the smaller brick plants of the state work on material obtained from loess deposits. The clayey loams of this class are widely distributed, but are nowhere of great thickness or value.

BLATCHLEY, W. S., AND ASHLEY, G. H. *The Lakes of Northern Indiana and their Associated Marl Deposits.* Twenty-fifth Ann. Rept. Indiana Dept. Geology and Natural Resources. Pp. 31–321, Pls. 1 and 6–12, Figs. 1–70, 1901.

The origin and uses of marl are first discussed, issue being taken with C. A. Davis on some points connected with the importance of Characae in the formation of marl deposits. The marl deposits of the state are then discussed separately in great detail.

Marl deposits of sufficient size to justify the erection of cement plants occur in Indiana only in the three northern tiers of counties. Areally, the largest of these deposits is in Lake Wawasee, which contains about 1,700 acres, while the maximum thickness (45 feet) is reported from Turkey Lake, Lagrange co. A deposit of marl equal to one covering 160 acres, ten feet thick, will supply for thirty years a plant with a capacity of 500 barrels per day· Deposits of such size are termed "workable deposits" in the present report. Thirty-two such deposits were found and are described and mapped in detail. A number of other deposits are described which, though of sufficient size, have the larger part of their area covered by ten feet or more of water and are therefore not at present workable. Improved appliances for raising marl from beneath such depths of water would render these deposits available.

BLATCHLEY, W. S. *Portland Cement.* Twenty-fifth Ann. Rept. Indiana Dept. Geology and Natural Resources. Pp. 1–30, Pls. 2–5, 1901.

A summary of the history, uses, composition, manufacture, and testing of Portland cement is followed by a brief history of the industry in Indiana.

Portland cement was first manufactured in Indiana at South Bend in 1877, from marl and clay burned in dome kilns. Operated with varying fortune, this plant was shut down finally in 1898. Two plants, also using marl and clay, but burning the mixture in rotary kilns, commenced operations in 1900, and at the time of report three additional plants were in prospect.

CUMMINGS, URIAH. [*Production of*] *American Rock Cement* [*in the U. S. during 1899*]. Twenty-first Ann. Rept. U. S. Geol. Surv., Pt. VI continued, pp. 407–411, 1901.

Résumé of the condition of the American natural cement industry during 1899, with statistics of production. Analyses and tests are quoted of a Portland cement manufactured at Chattanooga, Tenn., by burning a natural rock without admixture.

ECKEL, E. C. *The Portland Cement Industry in New York.* Engineering News, Vol. XLV, pp. 365–367, 1901.

Résumé of early history of Portland cement manufacture in New York, with descriptions of the six plants operating in 1900, and notes on the technology.

Until recently most New York plants used a mixture of marl and clay, burned in dome kilns. At present, however, the use of rotary kilns, operating on mixtures of hard limestone and clay, is increasing rapidly, half the plants in operation in 1900 being of this type.

Slag Cement Manufacture in Alabama. Eng. News, Vol. XLVII, pp. 1–62, 1902.

Description of two slag cement plants operating in Alabama, with notes on technology of slag cement in general.

The Classification of the Crystalline Cements. Amer. Geologist, Vol. XXIX, pp. 146–154, March, 1902. Reprinted in Cement, Vol. III, pp. 109–114, May, 1902. Reprinted in part in Engineering News, Vol. XLVI, p. 354, May 1, 1902.

A classification of cementing materials, with notes on raw materials, technology, and the properties of the various products. The grouping offered is as follows:

I. *Simple cements;* including those materials which are produced by the expulsion of a liquid or gas from the raw material; and whose set is due to the simple reabsorption of the same liquid or gas and a reassumption of original composition.

I*a*. *Hydrate cements;* set due to reabsorption of water. Plaster-of-Paris, cement plasters, Keene's cement, Parian cement, etc.

I*b*. *Carbonate cements;* set due to reabsorption of carbon dioxide. Limes, magnesian limes, etc.

II. *Complex cements;* including those cementing materials whose set is due to the formation of new compounds during manufacture or use.

II*a*. *Silicate cements;* set due to the formation of silicates. Hydraulic limes, natural cements, Portland cement, pozzuolanic cements.

II*b*. *Oxychloride cements;* set due to the formation of oxychlorides. Sorel stone, etc.

FREAR, WILLIAM, *The Use of Lime upon Pennsylvania Soils.* Bulletin 61, Pa. Dept. Agriculture. 170 pp., 1900.

Principally a discussion of lime in its relation to agriculture, but contains also very satisfactory accounts of limestones (in general) and lime-burning, with 273 analyses of Pennsylvania limestones, mostly compiled from reports of the Second Geological Survey of that state.

HARRIS, G. D., and VEATCH, A. C. *General Geology* (*of Louisiana*). Geological Survey of Louisiana, Report for 1899. Pp. 55–138, Pls. 1–11, Figs. 2–5, geological maps.

Report on the stratigraphic and economic geology of the state. The matter of clays, limestones, sandstones, and gravels (pp. 127–132) is here summarized.

Good brick clays are common in the alluvium and yellow loam, and are also found at several places in the hill-lands. The Eocene clays commonly lack plasticity, though some beds occur which will make a fair quality of earthenware. Good potter's clay occurs in the Lignitic, near Robeline, where it has been utilized. The clays of the Grand Gulf hills seem to be more promising than any others in the state, good exposures occurring in Catahoula and Vernon parishes.

The sandstones of the state are of two classes; the ferruginous sandstones of the Eocene and Lafayette, and the siliceous sandstones of the Grand Gulf. The former are widely distributed, but are unimportant as structural materials. The siliceous Grand Gulf sandstones are of greater value, and have been used for jetty work and railroad ballast.

Limestones of Cretaceous age outcrop at Winnfield, Coochie Brake, and Bayou Chicot. The first is a pure limestone, which may be used for lime, but not for building stone. The other two are of greater value for structural purposes. Limestone concretions occurring in the Tertiary are of local importance for lime or road metal.

The gravels of the Lafayette are rather extensively used as road metal and railroad ballast.

HILLEBRAND, W. F. *Some Principles and Methods of Rock Analysis.* Bull. 176, U. S. Geol. Surv. 8vo. Pp. 115, Figs. 15, 1900.

Detailed discussion of the methods to be followed in analyses of the silicate rocks. Stress is laid on the importance of complete and thorough analyses, and the chemist is warned against neglect to determine elements (such as strontium, barium, vanadium, etc.), often disregarded as unimportant.

HOPKINS, T. C. *Clays and Clay Industries of Pennsylvania.* III, *Clays of the Great Valley and South Mountain Areas.* Appendix to the Ann. Rept. Pa. State College for 1889–1900. 8vo, pp. 45, 1900.

Over half the paper is taken up with a discussion of the white clays of the Great Valley; the remainder containing short chapters on respectively the red brick, paving brick, and tile industries; with a brief account of the economic products, other than clays, of southeastern Pennsylvania.

The most valuable clay deposits in southeastern Pennsylvania are those occurring in the Cambro-Silurian areas of the Great Valley and South Mountains. These clays are typically white; commonly bluish-white to gray on fresh exposures, but soon weathering pure white. Closely associated with the white clays are others stained more or less by iron oxide, and being therefore yellow to brown in color. The white clays are invariably high in silica, and low in alumina. Their iron content is also low, but the alkalies are always too high to give refractory material. Genetically, the white clays are direct decomposition products of light-colored hydromica slates which occur interbedded with other Cambro-Ordivician rocks. In certain openings the clays are shown grading into the undecomposed slates. They were originally intercalated beds in a series of quartzites, limestones, etc.; but on the weathering of the rocks the clay derived from the disintegrated slates crept down hillsides, filled cavities in the other rocks, etc.—so that now the deposits are somewhat irregular, lenticular masses of varying extent. At present the clays are largely used in the manufacture of paper, and to a less extent for white tiles, and white and enameled brick.

Red building brick is made, in the Great Valley, from residual limestone clays, residual shale clays, and alluvial deposits. Of these classes the first is the most important. The clays residual from limestone make good brick, though often carrying numerous fragments of limestone, quartz, etc.

Vitrified brick is manufactured at six plants. Three of these use Triassic shale; one, Hudson River shale; while the remaining two use shales from the Cambro-Ordovician series.

Ornamental brick and tile are manufactured at several plants, various materials being in use, including clays, slates, etc.

IHLSENG, MAGNUS C. *The Road-Making Materials of Pennsylvania.* Bulletin 69, Pa. Dept. Agriculture. Pp. 104, Figs. 1–17, relief map, colored geologic map, 1900.

General discussion of road materials, their qualities, and testing; influence of topography on road construction; methods of constructing and repairing roads, etc.

Scattered notes on various Pennsylvania road materials, with a section on the distribution, by counties, of such materials.

LEWIS, F. H. *Hydraulic Cement Industry in the United States in 1899.* Mineral Industry, Vol. VIII, pp. 84, 85, 1900.

Résumé of progress in the American cement industry during 1899.

Cement Industry in the United States in 1900. Mineral Industry, Vol. IX, pp. 77–82, 1901.

Résumé of the conditions of the American Portland cement industry during 1900—a year marked by overproduction and low prices.

LEWIS, F. H., NEWBERRY, S. B., and others. *The Cement Industry.* 8vo. Pp. 235, Figs. 152. New York, 1900.

A collection of articles reprinted from issues of the Engineering Record. Detailed descriptions of a number of American cement plants, with sketches of the condition of the cement industry in various European countries; and separate chapters on the general technology of Portland cement (NEWBERRY) and the rotary kiln process (LEWIS).

MERRILL, G. P. *Guide to the Study of the Collections in the Section of of Applied Geology; the Non-metallic Minerals.* Rept. U. S. Nat. Mus. for 1899. Pp. 155–483, Pls. 1–30, 1901.

Comment.—The material contained in this handbook cannot well be summarized. The sections of interest in the present connection are those on quartz (p. 215); flint (216); limestones, mortars, and cements (pp. 264–270); dolomite (p. 274); magnesite (p. 275); feldspars (p. 281); clays (pp. 325–353); gypsum (pp. 406–411); and road-making materials (p. 482). The treatment of these subjects is, in general, excellent, that of clays being eminently so. The discussion of the cements, particularly Portland, is less satisfactory.

NEWBERRY, S. B. [*Production of*] *Portland Cement* [*in the United States during 1899*]. Twenty-first Ann. Rept. U. S. Geol. Surv., Pt. VI continued. Pp. 393–406, 1901.

Résumé of the condition of the American Portland cement industry during 1899, with statistics of production. The method of calculating the proportions of the ingredients in a Portland cement mixture is discussed and exemplified.

RIES, HEINRICH. *Clays of New York.* Bulletin 35, New York State Museum. 8vo, pp. 455, Pls. 140, map, 1900.

Detailed discussion of the origin, properties, testing and uses of clays, and manufacture of clay products; with descriptions of the clay deposits of New York and of the industries based on them. The section on the geologic distribution of clays in New York (pp. 275–311) is here summarized, together with the sections on shales (pp. 825–841) and feldspar and quartz (pp. 841–844).

Small deposits of residual clay, of little or no economic importance, have been found at various points in Dutchess county.

The sedimentary clays are numerous and important, representing three geologic periods — Quaternary, Tertiary and Cretaceous. The latter two occur only on Long and Staten Islands, all the clays of the mainland being Quaternary.

Local basin-shaped deposits of Quaternary clays occur at many points in the central, western and southwestern portions of the state. These deposits are doubtless on the sites of former ponds, formed commonly by the damming of valleys, and later filled with the sediment of streams from the retreating ice sheet. A number of these deposits are of economic importance, and some are now worked.

The most important and extensive clay deposits in the state, however, are those in the Hudson valley. The Quaternary deposits here are of two types (1) estuary deposits of fine stratified sand and blue and yellow clays; (2) cross bedded delta deposits of coarser material. The clay is usually blue, weathered yellow where exposed. It is markedly stratified horizontally, the layers of clay being separated by extremely thin laminæ of sand. At many localities the clay is overlain by the delta deposits of rivers tributary to the Hudson. The Quaternary history of the region is summed up as follows: During the retreat of the ice sheet from the Hudson valley the glacial streams deposited as kames a great amount of ground up material, principally shale. Subsequent to the retreat there was a depression of the land amounting to 80 feet at New York city and 360 feet near Schenectady. During this depression a great amount of plastic clay was deposited, produced by glacial attrition of shales and limestones. The upper portion of the clay is more siliceous, and it is overlain by an extensive deposit of sand, indicating a change in the nature of the material washed into the estuary. During the period of submergence much of the siliceous matter washed into the estuary was deposited at the mouths of tributary streams to form deltas.

The clays of the Champlain valley are estuary deposits of the same age as the Hudson river clays. They underlie terraces bordering Lake Champlain, and now standing at an elevation of 393′ A. T. Extension erosion has removed much of the clays and sands, and it is only at sheltered points that the terraces are now prominent. The clays are worked for brick at Plattsburg and other localities.

Cretaceous clays occur on Staten Island, and have been worked extensively at Kreischerville and other points, the material being used in the manufacture of fire-brick, etc.

[1] "There is still some doubt as to the exact conditions under which the beds of clay and gravel which form the greater portion of Long Island were deposited, but it is probable that the clays represent shallow water marine deposits of Cretaceous and Tertiary age . . . . The age of the clays is still largely a matter of speculation, and will probably remain so in many cases unless paleontologic evidence is forthcoming. Those on Gardiner's Island are quite recent, as shown by the contained fossils, and the clay on Little Neck is Cretaceous. The proof of the age of the Glen Cove clay is not absolute . . . . The clays at Center Island, West Neck, Fresh Pond, and Fisher's Island are very similar in appearance and composition, and are very probably of the same age, possibly Tertiary, but we lack paleontologic or stratigraphic evidence. At West Neck, the clay underlies the yellow gravel and the latter is covered by the drift, so that is pre Pleistocene."

Shales occur in New York in the Hudson River, Medina, Clinton, Niagara, Salina, Hamilton, Portage and Chemung groups. Of these, the last three are the most important in the present connection, though Medina shales are used in Ontario in the manufacture of pressed brick, while vitrified brick are made from Salina shales at Warners, Onondaga county, N. Y. Hamilton shales are utilized at Cairo, Greene county, in the manufacture of paving brick; and at Jewettville, Erie county, for pressed brick manufacture. Sewer pipe, drain tile and terra cotta are made from Portage shales at Angola, Erie county. Chemung shales are utilized at Jamestown, Chautauqua county; Alfred, Allegany county; Hornellsville, and Corning, Steuben county; and Horseheads, Chemung county.

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[1] In regard to the Long Island clays the author has been quoted verbatim, as the statements could not well be summarized.—E. C. E.

Feldspar and quartz are obtained from large pegmatite veins occurring near Bedford, Westchester county, and are shipped to the potteries at Trenton, N. J.

Report on Louisiana Clay Samples. Geological Survey of Louisiana, Report for 1899. Pp. 263–275.

Discussion of origin, composition and properties of clay, followed by reports on physical tests of six samples of clay. All of the clays tested could be used in the manufacture of pressed brick, while one could also be used for paving brick and two for earthenware.

Clay and its Manufacture into Brick and Tile. Mineral Industry, Vol. IX, pp. 93–135, 12 figures, 1901.

Detailed discussion of the manufacture of building and paving brick, roofing and floor tile, terra cotta and sewer pipe.

Report on the Clays of Maryland. Special Publication, Vol. IV, Pt. III, Maryland Geological Survey. 8vo, pp. 203–507; Pls. XIX–LXIX, including six geologic maps; Figs. 5–34, 1902.

A general discussion of the origin, properties, uses and technology of clays is followed by detailed descriptions of the Maryland clays, and a résumé of the industries based on them.

According to Shattuck, the Pleistocene of Maryland is divisible into three formations; the Talbot, Wicomico, and Sunderland. The newest of these, the Talbot, does not exceed forty-five feet in thickness; and often carries lenses of greenish-black clay. The Wicomico, which is from forty-five to one hundred feet thick, seldom contains clay deposits of economic value. The Sunderland contains clay beds which are well shown in Calvert and St. Mary's counties. None of the Pleistocene clays are used for anything except common brick, though occasionally clays occur fit for tile or terra cotta.

The Neocene is represented by the Lafayette and Chesapeake formations. The Lafayette consists of gravels, sands and clays, very irregularly stratified, and changing character rapidly along the deposition planes. The Chesapeake consists chiefly of sands of marls with only local developments of clay.

Clark and Martin divide the Maryland Eocene as follows:

GROUP.	FORMATION.	MEMBER.
Pamunkey	Nanjemoy	Woodstock Potapaco.
	Aquia	Paspotansa Piscataway.

Of these four members only one, the Potapaco, contains clay deposits of importance. The Potapaco consists of argillaceous (and often gypseous) green sand, with a lower clayey member which is shown south of South River. The clay is a fine grained material with occasional streaks of sand, and is in places twenty feet thick. It is fairly plastic, abundant, and exposed near tidewater; suitable for use in the manufacture of pressed brick and possibly of paving brick.

The Jurassic and Cretaceous of Maryland are divisible as follows:

Upper Cretaceous	Rancocas Monmouth Matawan	
Lower Cretaceous	Raritan[2] Patapsco	Potomac group.
Jurassic (?)	Arundel Patuxent.	

The Upper Cretaceous formations include no clay deposits of economic value; but the Potomac group is of great importance. The Raritan[1] consists usually of white sands and light colored clays, and reaches a thickness in central Maryland of one hundred[2] feet. Raritan clays are found in Cecil, Kent, Harford, Baltimore, Anne Arundel, Prince George's, Howard, and Montgomery counties. They are worked at several points for use in pressed brick manufacture; while potter's clay occurs in places. The Patapsco includes brightly colored mottled clays, with light sands and clays, and has a maximum thickness of about 200 feet. In Cecil county a bed of bluish stoneware clay often underlies the variegated clays. Refractory clays, as well as brick clays, occur, and the Patapsco clays have been exploited to a considerable extent. The Arundel contains lenses of bluish, siliceous, plastic clays, often carrying iron concretions. The clays are largely used in the manufacture of common and pressed brick, terra-cotta, roofing tile, and common pottery. The Patuxent consists largely of sands, with occasional beds of sandy clay, and is, in this regard, the least important member of the Potomac.

Shales from the different formations of the Carboniferous, Devonian and Silurian have been tested and found suitable for various uses. At present only two of these formations furnish material of economic importance, these being the Pottsville formation of the Carboniferous and the Jennings formation of the Devonian. Both flint clays and plastic clays occur in the Pottsville formation, the well-known Mt. Savage fire clay being an example of the former. The beds have been opened near Frostburg, at Mt. Savage and west of Ellerslie; and will probably become of even greater economic importance. Shales of the Jennings formation are extensively used in the manufacture of paving brick at Cumberland.

Kaolin occurs at many points in the area underlain by Algonkian rocks, notably in Cecil county. These residual clays, having been derived from feldspathic rocks low in iron-bearing minerals, are light colored and burn white. Only one company is actually at work mining and washing this material, but the industry will probably increase rapidly in importance. Owing to the presence of Patuxent and Columbia beds, the kaolin is rarely exposed at the surface, the necessary stripping varying from two to forty feet.

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[1] On page 397 the Raritan is excluded from the Potomac, but is included in it on pages 399 *et seq.*—E. C. E.

[2] Elsewhere in the volume stated as 500 feet.—E. C. E.

Less-pure residual clays, derived from rocks of various kinds and ages, are found at many points in the state, and are used in places for brick manufacture.

SIEBENTHAL, C. E. *The Silver Creek Hydraulic Limestone of Southeastern Indiana.* Twenty-fifth Ann. Rept. Indiana Dept. Geology and Natural Resources Pp. 331–389, Pl. 14, colored geologic map, 1901.

Divided into three sections relating respectively to the stratigraphy, topography and economic geology of the Silver Creek limestones.

A historical résumé of opinions in regard to the stratigraphy of southeastern Indiana is followed by descriptions of local distribution and structure. The Devonian and sub-Carboniferous formations occurring in this area, with their New York and Mississippian (paleontologic) equivalents, are:

Sub-Carboniferous	Knobstone	Kinderhook.
	Rockford limestone	Choteau.
Devonian	New Albany black shale	Genesee.
	Sellersburg limestone	Hamilton.
	Silver Creek hydraulic limestone	Hamilton.
	Jeffersonville limestone	Corniferous.
	Pendleton sandstone	Schoharie.

The topography is briefly mentioned. Pleistocene terraces are described and mapped, and a possible preglacial channel of the Ohio River is pointed out.

The Silver Creek hydraulic limestone is massive, very fine grained and usually fossiliferous. In color it varies from light to dark or bluish-drab, weathering buff. In composition it varies between the following limits: Calcium carbonate 52 per cent. to 62 per cent.; magnesium carbonate 16 per cent. to 35 per cent.; silica 9.5 per cent. to 18.5 per cent.; ferric oxide 1.4 per cent. to 2.0 per cent.; alumina 2 to 5 per cent. The cement rock is obtained by quarrying or mining, according to the situation; blasted out by dynamite and sledged to proper size (6″–12″) for the kilns. The latter are continuous up-draft kilns, and require about seventy-two hours for calcination. The burned rock is sent through crushers, "re-grinders," and rock-emery mills. During 1900, thirteen plants, working 116 kilns, were in operation, the total product being 2,512,000 barrels.